Appeal No. 2022-2173

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

PARKERVISION, INC.,
***Appellant*,**

v.

KATHERINE K. VIDAL, UNDER SECRETARY OF COMMERCE FOR INTELLECTUAL PROPERTY AND DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE,
***Intervenor*.**

Appeal from the United States Patent and Trademark Office,
Patent Trial and Appeal Board in No. IPR2021-00346

BRIEF FOR INTERVENOR—DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

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July 3, 2023

Claim 1 in U.S. Patent No. 8,190,108:

A frequency conversion module, comprising:

a first switch configured to up-convert a signal based on a control signal and a bias signal;

wherein said signal are routed to said frequency conversion module via a second switch; and

wherein said signal is transmitted by an antenna connected to a third switch.

Appx185.

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STATEMENT OF RELATED CASES

Beyond the cases identified in the opening brief, the Director is not aware of any other appeal in connection with this case that has previously been before this Court or that is currently pending in any other court. The Director is also unaware of any related cases pending in this or any other court that will directly affect, or be directly affected by, this Court's decision in the pending appeal.

I. STATEMENT OF THE ISSUE

ParkerVision owns U.S. Patent No. 8,190,108, covering a frequency conversion module that converts a signal from a lower frequency to a higher frequency (i.e., up-conversion). The claimed frequency conversion module includes a "first switch" configured to up-convert a signal based on a control signal and a bias signal. Additionally, the signal to be up-converted is passed to the frequency conversion module via a "second switch" and the up-converted signal is transmitted by an antenna via a "third switch."

Intel filed a petition for inter partes review of claims 1, 6-9, 12, and 17-20, contending that independent claims 1 and 12 would have been obvious in view of Downey and Sedra.[1] Downey discloses an RF transceiver that can rapidly switch between a transmit mode and a receive mode. In the transmit mode, a signal passes through a component referred to as a "frequency tripler." The frequency tripler includes an inverter that up-converts the signal. Sedra discloses that an inverter, such as the inverter included in Downey's frequency tripler, acts as a switch (i.e., the "first switch"). Sedra's inverter is configured in the same manner as the "first switch" disclosed in the '108 patent.

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[1] The Hahnel prior art reference was used in combination with Downey and Sedra for the challenged dependent claims (Appx7-8), but ParkerVision raises no argument specific to any of those claims.

Before the signal in Downey can enter the frequency tripler, it passes through a low pass filter that includes a diode that functions as a switch (i.e., the "second switch"). Finally, before the up-converted signal in Downey is transmitted by an antenna, it passes through a transistor that functions as a switch (i.e., the "third switch"). In a final written decision, the Board agreed with Intel and found all challenged claims to be unpatentable.

ParkerVision raises two primary arguments on appeal. First, ParkerVision argues that the components in Downey identified as the first switch and third switch are not switches because they function as amplifiers. The Board rejected this argument based on Intel's evidence showing that switches and amplifiers are not mutually exclusive, and that an electrical component can act as both a switch and an amplifier. Specifically, the Board weighed dueling expert testimony from the parties and found Intel's expert to be more credible.

Second, ParkerVision argues that Downey does not disclose the "second switch" under the proper construction of "switch." Before the Board, the parties agreed that a "switch" is "an electronic device for opening and closing a circuit," but ParkerVision sought to include the additional requirement that the opening and closing is "dictated by an independent control input." The Board rejected ParkerVision's proposed construction, finding nothing in the claim language or the specification that mandated the inclusion of such a requirement. Moreover, the

Board found that the specification includes a "Terminology" section that makes clear that an independent control input is not a requirement to control a switch.

The issues on appeal are thus:

1) Whether, in construing the claim term "switch," the Board erred by not requiring that the opening and closing of a switch is "dictated by an independent control input;" and
2) Whether substantial evidence supports the Board's findings that (a) the combination of Downey and Sedra discloses the "first switch," "second switch," and "third switch" limitations; and (b) a skilled artisan would have been motivated to combine the references.

Because the Board did not err in deciding these issues, the Court should affirm the Board's unpatentability finding.

II. STATEMENT OF THE CASE

On July 22, 2021, the Board instituted IPR2021-00346 based on a petition filed by Intel Corp. *See* Appx2258-2259. The IPR proceeding concerned claims 1, 6-9, 12, and 17-20 of U.S. Patent No. 8,190,108, titled "Method and System for Frequency Up-Conversion." *Id.*; Appx79-186. On June 30, 2022, the Board issued a final written decision finding that Intel met its burden to show that claims

1 and 12 would have been obvious in view of Downey[2] and Sedra,[3] and that claims 6-9 and 17-20 would have been obvious in view of Downey, Sedra, and Hahnel.[4] Appx1-73.

ParkerVision appealed, and Intel withdrew from the appeal. ECF No. 20. The USPTO has intervened to defend the Board's final written decision. *See* 35 U.S.C. § 143.

A. Claimed Invention: System for Frequency Up-Conversion

The '108 patent is "directed to methods and systems to up-convert a signal from a lower frequency to a higher frequency." Appx153 at col. 1, ll. 65-67; *see also* Appx157 at col. 9, ll. 44-46 (defining "up conversion"). The specification discloses a transceiver that can transmit and receive data, but cannot do both simultaneously. Appx179 at col. 54, l. 34-35. Figures 54A and 54B in the specification, shown below, depict an exemplary transceiver circuit that can perform the up-conversion.

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[2] U.S. Patent No. 5,239,686. Appx441-450.

[3] Adel S. Sedra et al., MICROELECTRONIC CIRCUITS (3rd ed. 1991). Appx451-508.

[4] U.S. Patent No. 2,730,624.

FIG. 54B

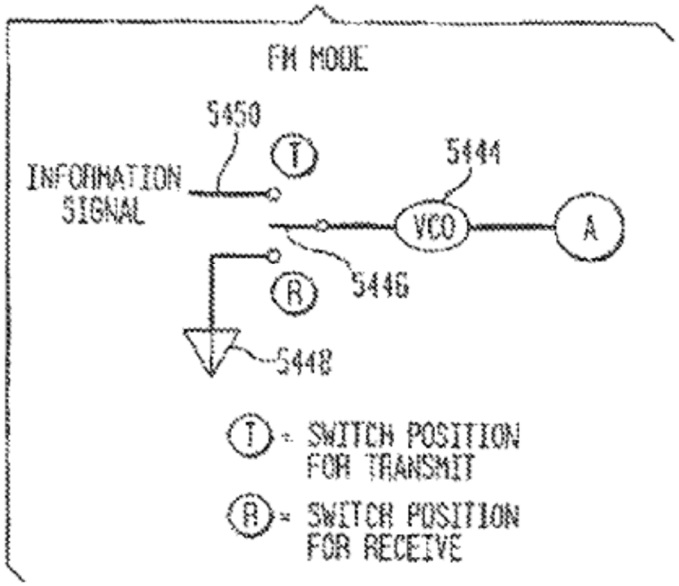
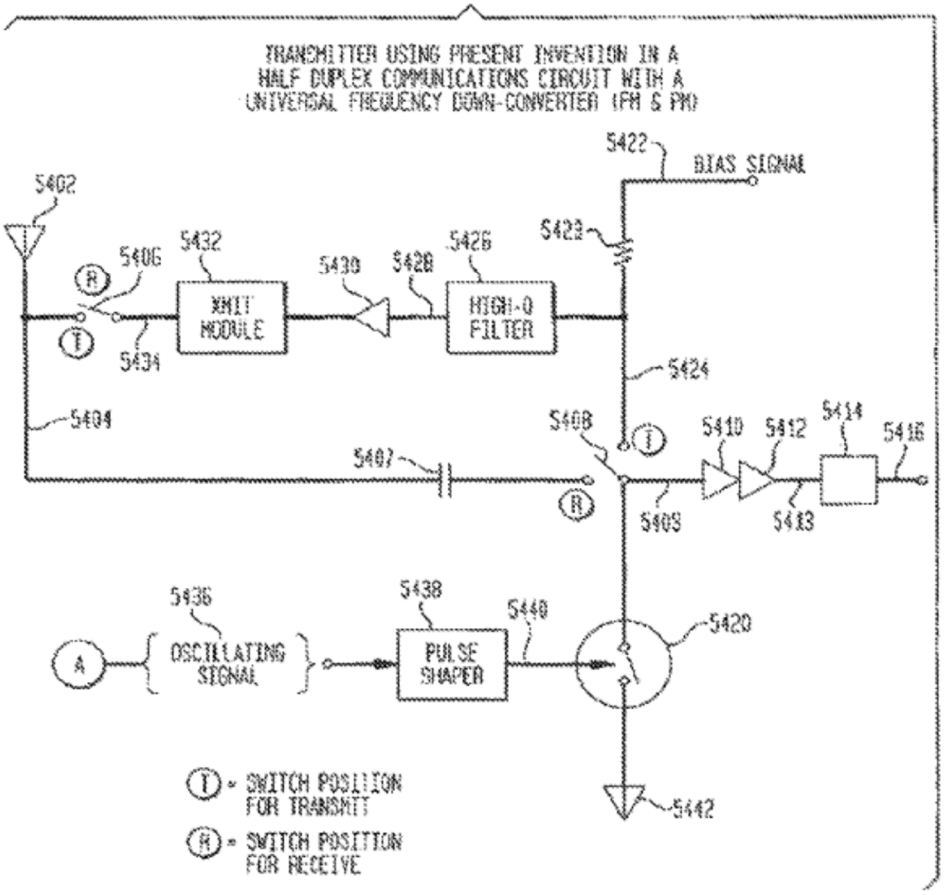


FIG. 54A



Appx138-139.[5]

An information signal **5450** is supplied to a switch **5446**. Appx180 at col. 55, ll. 7-9. The position of the switch **5446** changes depending on whether the circuit is in transmit or receive mode. Appx179 at col. 54, ll. 39-41; Appx180 at col. 55, ll. 5-7. In transmit mode, the signal passes to a voltage controlled oscillator **5444** ("VCO"). Appx180 at col. 55, ll. 7-9.

The VCO **5444** creates a modulated[6] oscillating[7] signal **5436** corresponding to the information signal. Appx180 at col. 55, ll. 7-9. The frequency of the oscillating signal is a sub-harmonic[8] of the desired frequency of the output signal. Appx178 at col. 52, ll. 2-11. This signal is referred to as the "control signal." Appx173 at col. 41, ll. 14-21. After passing through a pulse shaper **5438**, the

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[5] The output from Figure 54B, labeled as signal A, is the oscillating signal **5436** in Figure 54A.

[6] Modulation refers to the process of imprinting a low frequency baseband signal onto a higher frequency carrier signal for transmission. *See, e.g.*, Br. at 5-6; Appx301-307, ¶¶ 30-34.

[7] An "oscillating" signal is a repeating signal that oscillates between a minimum voltage and a maximum voltage (e.g., a sinusoidal wave). *See, e.g.*, Appx94; Appx301-302, ¶ 30.

[8] A "harmonic" is an up-converted signal with a frequency that is an integer multiple of the original signal. Appx156 at col. 8, ll. 25-33. A "sub-harmonic" is a signal with a frequency that is an integer sub-multiple of the up-converted signal. Appx157 at col. 9, ll. 24-34.

control signal controls the position of the switch **5420**, where the switch opens or closes depending on the voltage of the control signal. Appx180 at col. 55, ll. 12-14. The switch **5420** has two terminals—one terminal connected to ground **5442** and one terminal connected to a fixed voltage bias signal **5422**. *Id.* at col. 55, ll. 14-17; *see also* Appx168 at col. 32, ll. 11-12 (noting that a bias signal "is generally a fixed voltage"). When the switch opens and closes, the output from the switch changes between 0V and the fixed voltage of the bias signal. The switch **5420** transforms the oscillating control signal into an up-converted signal including many sinusoidal waveforms at different harmonic frequencies (referred to as a "harmonically rich signal"). Appx180 at col. 55, ll. 17-18; *see also* Appx312, ¶¶ 44-45.

The harmonically rich signal passes through a harmonic filter **5426** that removes parts of the signal that do not have a frequency equal to the desired output frequency. Appx180 at col. 55, ll. 17-20. The signal with the desired frequency **5428** is amplified by an amplifier module **5430**. *Id.* at col. 55, ll. 20-21. Finally, the amplified signal passes to an antenna for transmission. *Id.* at col. 55, ll. 21-25. When the transceiver is in transmit mode, the switch **5406** will be closed to connect the signal to the antenna **5402**. *Id.*

Representative claim 1 in the '108 patent recites:

A frequency conversion module, comprising:

a first switch configured to up-convert a signal based on a control signal and a bias signal;

wherein said signal are routed to said frequency conversion module via a second switch; and

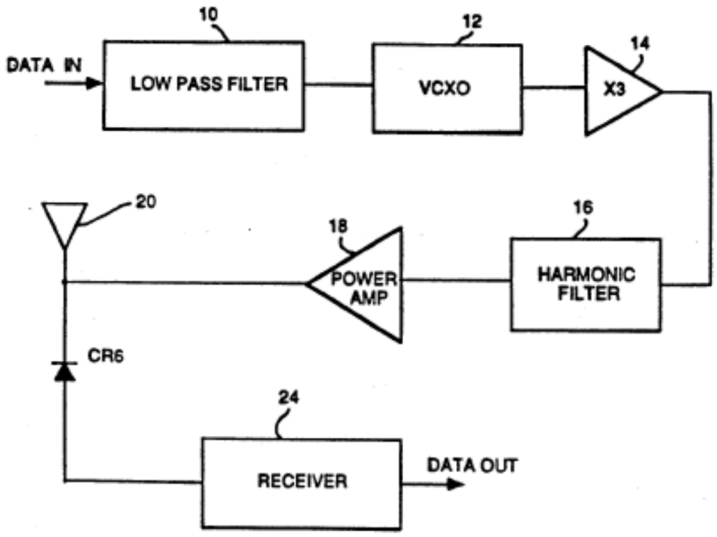
wherein said signal is transmitted by an antenna connected to a third switch.

Appx185.

B. Prior Art

1. Downey: RF Transceiver Including Frequency Up-Conversion

Downey discloses "a lightweight, compact and inexpensive RF transceiver that can switch rapidly from the receive mode to the transmit mode and yet still achieve high levels of receiver sensitivity." Appx446 at col. 1, ll. 52-55. Figure 1, shown below, discloses a block diagram of the RF transceiver. *Id.* at col. 2, ll. 53-54.



Appx442.

The input signal first passes through a low pass filter **10** "where high frequency components of the data bit stream are removed." Appx446 at col. 2, ll. 58-59. The output of the low pass filter **10** moves to a "voltage controlled crystal oscillator (VXCO) **12**, which frequency modulates the oscillator's RF signal in accordance with the data to be transmitted." *Id.* at col. 2, ll. 60-63. The modulated RF output signal is then input to a frequency tripler **14** "where harmonics, particularly the third harmonic, of the crystal oscillator signal are generated." Appx446-447 at col. 2, l. 67 to col. 3, l. 2. After passing through a harmonic filter **16**, the signal moves to power amplifier **18** "where the signal power is boosted to a level sufficient for transmission." Appx447 at col. 3, ll. 6-7. The power amplifier **18** is coupled to an antenna **20** to transmit the signal. *Id.* at col. 3, ll. 8-10.

In Figure 2a, shown below, Downey shows a detailed view of the low pass filter **10**. The input signal, which enters the circuit at the CP1 pin, must pass through the network including diode CR9. Appx447 at col. 3, ll. 21-31. Intel's expert witness, Dr. Daniel van der Weide, testified that a skilled artisan "would understand that a diode is a type of switch." Appx332, ¶ 65.

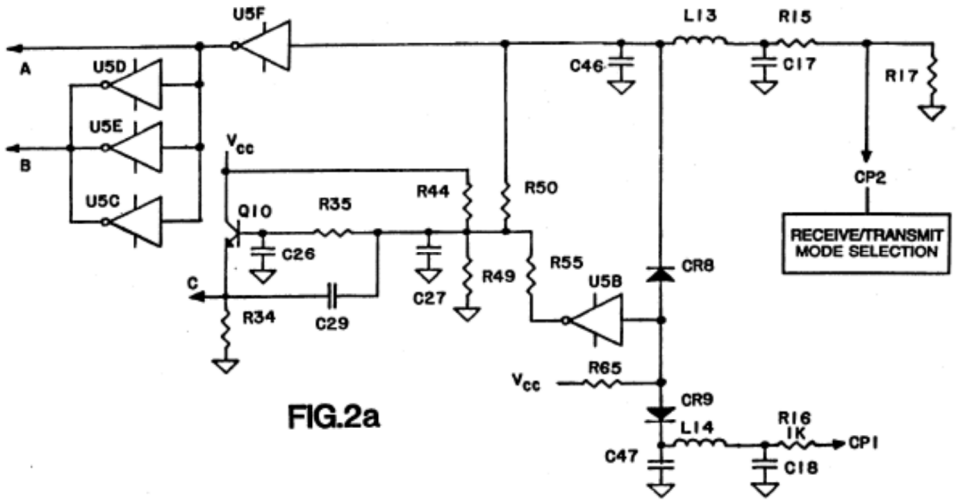


FIG.2a

Appx443.

In Figure 2c, shown below, Downey discloses a detailed view of the frequency tripler **14**, with signal D representing the output of VCXO **12**. Appx447 at col. 4, ll. 8-10. The frequency tripler **14** includes inverter U5A which is "operated as a non-linear amplifier to develop harmonics of the input signal, particularly the third harmonic which will drive the RF power amplifier." *Id.* at col. 4, ll. 10-13. Dr. van der Weide testified that a skilled artisan would have known that "inverters, such as the inverter U5A in Downey, are implemented with switches." Appx337, ¶ 68. Moreover, Dr. van der Weide testified that the input signal to the inverter (labeled as signal D) is the control signal and the signal labeled V_{CC} is the bias signal. Appx336-338, ¶¶ 67-69.

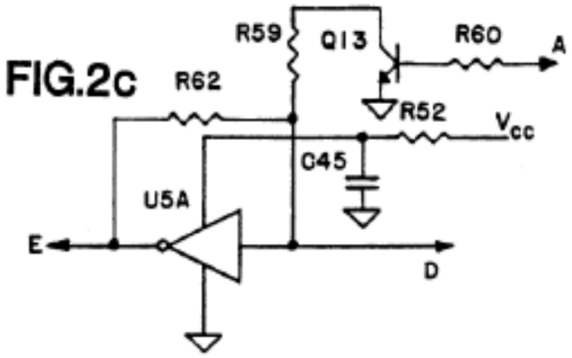


FIG.2c

Appx444.

In Figure 2e, shown below, Downey discloses a detailed view of the power amplifier **18** and antenna **20**. Appx447 at col. 4, ll. 33-34. The output of the harmonic filter **16** (signal F) is applied to transistor Q11. *Id.* at col. 4, ll. 34-35. Dr. van der Weide testified that transistor Q11 acts as a switch and controls whether the antenna **20** transmits the signal. Appx340-342, ¶ 72.

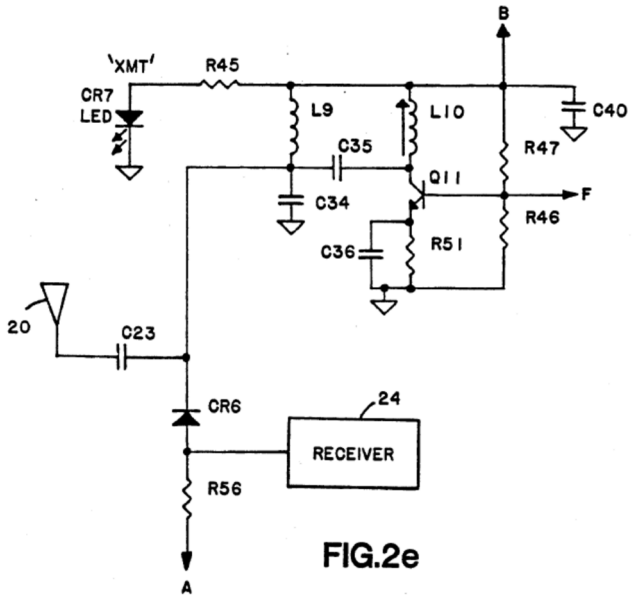


FIG.2e

Appx445.

2. Sedra: Logic Inverters as Switches

Sedra is a microelectronic circuits textbook. Appx451; Appx351, ¶ 88. It includes a chapter about MOS digital circuits, and notes the benefits of MOS transistors: "[t]he small size, ease of fabrication, and low power dissipation of MOSFETs enable extremely high levels of integration of both logic and memory circuits." Appx476.

In discussing logic inverters, Sedra explains that "[t]he logic inverter is basically a voltage-controlled switch." Appx478; *see also* Appx479 (stating that "[p]ractical implementations of the logic inverter utilize a transistor (a MOSFET or a BJT) as the switching element"). Sedra includes a schematic representation of a logic inverter:

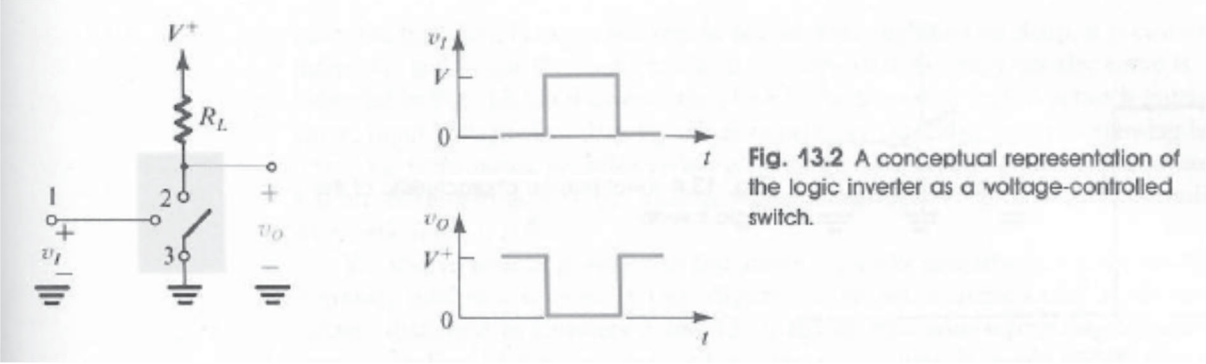


Fig. 13.2 A conceptual representation of the logic inverter as a voltage-controlled switch.

Appx479. As the name implies, and inverter accepts an input signal and outputs the inverse of the input signal. Appx352, ¶ 89. As shown in the schematic, when input voltage v_I is low, the switch is open and the output voltage v_O is high (equal

to supply voltage V^+). Appx478-479. When the input voltage v_I is high, the switch is closed and the output voltage v_O is low. *Id.*

C. The Board's Final Written Decision

The Board issued a final written decision finding that Intel had met its burden to show that claims 1, 6-9, 12, and 17-20 of the '108 patent are unpatentable. Appx1-73. The Board began by construing the claim term "switch." The parties' dispute centered on whether the opening and closing of a switch must be dictated by "an independent control input." Appx12-15. The Board acknowledged that two district courts had construed the same term and adopted ParkerVision's proposed construction. Appx15-19. The Board noted that it considered these constructions, but neither district court provided any reasoned analysis to support the construction. *Id.*

The Board then turned to the claim language, and found that while claim 1 expressly requires a control signal for the first switch, it is silent with regard to the second and third switches. Appx20. According to the Board, this "suggest[s] that the patentees understood how to recite a control signal to the switch when the patentees intended to do so, but did not add an independent control input requirement to any of the switches." *Id.*

The specification includes a lexicographic definition of "Control a switch" that states that if a switch is controlled by an electronic signal, the switch is

"typically" controlled by "a different signal than the signals connected to either terminal of the switch." Appx20-21 (quoting Appx156 at col. 7, ll. 57-64). Noting the inclusion of the non-limiting term "typically," the Board found that this definition does not require that the control of a switch is dictated by an independent control input. Appx21-23. Moreover, the Board reviewed the specification in general and found no evidence of a clear intention to limit the meaning of switch to require an independent control input. Appx23-24.

The Board considered the claim construction testimony put forth by ParkerVision's expert Dr. Michael Steer and found that it was "clearly at odds with the description of switch provided in the '108 patent." Appx25. Finally, the Board noted two additional points. First, Intel offered multiple dictionary definitions of "switch" that demonstrated that the "widely understood meaning of the term switch was a device for opening and closing a circuit." *Id.* Second, ParkerVision agreed with the proposed construction put forth by Intel in an earlier district court litigation. *Id.* In sum, the Board rejected ParkerVision's attempt to require that a "switch" is controlled by an "independent control input." Appx25-26.

Next, the Board considered whether the prior art taught or suggested the limitations in claim 1. The Board found that Downey discloses "[a] frequency conversion module" in the form of the frequency tripler. Appx31-32.

The Board found that the combination of Downey and Sedra discloses the "first switch configured to up-convert a signal based on a control signal and a bias signal." Appx39. The Board noted that Downey's frequency tripler includes inverter U5A. *Id.* While Downey does not disclose the components of the inverter, Sedra teaches that an inverter is "basically a voltage-controlled switch." Appx40 (quoting Appx478). Sedra further discloses that the switching element may be a MOSFET or BJT transistor. Appx41 (citing Appx479).

When comparing Sedra's schematic representation of a logic inverter to the up-conversion switch shown in the '108 patent figures, the Board found that the two have the same configuration and function in the same way. Appx40-41. The Board credited the testimony of Intel's expert, Dr. Daniel van der Weide, who testified that a skilled artisan would have understood from Sedra that a switch (such as a MOSFET or BJT transistor) connected to a voltage supply through a resistor is an inverter that could be used in Downey's frequency tripler circuit. Appx41-42. Additionally, the Board found that Downey's inverter uses the claimed control signal and bias signal. Appx46-48.

The Board found that Downey discloses that the signal is routed to the frequency conversion module via a second switch. Specifically, the Board found that diode CR9 in Downey's Figure 2a is the "second switch." Appx53-54. The Board relied on Dr. van der Weide's testimony explaining how diode CR9 acts as a

switch and is controlled by the value of the receive/transmit signal CP2. *Id.* The Board found that ParkerVision's arguments were based on its proposed construction of "switch," which the Board did not adopt. Appx51. The Board further considered ParkerVision's untimely argument that a diode is not a switch because it does not permit bidirectional current flow, but found that ParkerVision offered no evidentiary support for the assertion. Appx51-52.

The Board found that Downey discloses that the signal is transmitted by an antenna connected to a third switch. The Board identified transistor Q11 in Figure 2e of Downey as the claimed third switch. Appx57. The Board found that whether signal B in Figure 2e is high or low will determine whether transistor Q11 opens or closes, thereby determining whether signal F is passed to the antenna. *Id.* The Board credited Dr. van der Weide's testimony on this point. Appx57. The Board also credited Dr. van der Weide's testimony that a skilled artisan would have understood that a transistor such as Q11 functions as a switching amplifier that can act both as a switch and an amplifier. Appx58-59.

III. SUMMARY OF THE ARGUMENT

The claimed invention is directed to a frequency conversion module for up-converting an electronic signal. The module includes a "first switch" that performs the up-conversion based on a control signal and bias signal. The electronic signal

is passed to the frequency conversion module via a "second switch." And the up-converted signal is transmitted by an antenna via a "third switch."

The Board correctly determined that the claims would have been obvious to one of ordinary skill in the art in view of the combination of Downey and Sedra. Downey discloses an RF transceiver including a frequency tripler. Downey's frequency tripler includes a logic inverter, and Sedra teaches that a logic inverter is "basically a voltage-controlled switch." The Board correctly found that the references together disclose the claimed "first switch" that performs the up-conversion based on a control signal and bias signal. The Board also found that Downey's diode CR9 is the claimed "second switch" and transistor Q11 is the claimed "third switch."

ParkerVision raises two primary arguments in response. With respect to the "first switch" and "third switch" limitations, ParkerVision's argument hinges on the assertion that the corresponding components in Downey are amplifiers, not switches, and that the two are mutually exclusive. Thus, ParkerVision argues that a skilled artisan would not combine Downey and Sedra because it would change the operation of the frequency tripler in Downey and render it inoperable for its intended purpose. To the contrary, Intel argued that amplifiers and switches are not mutually exclusive, as there is such a thing as a "switching amplifier."

In support of their positions, the parties presented dueling expert opinions from Dr. Steer and Dr. van der Weide. The Board weighed the expert evidence and found Dr. van der Weide to be more credible because his testimony regarding the "first switch" and "third switch" limitations was fully consistent with the prior art and other electronics textbooks in the record, and Dr. Steer's testimony was not. Because this Court gives the Board broad deference in weighing the evidence before it, ParkerVision cannot demonstrate error by asking this Court to reweigh the expert evidence on appeal.

With respect to the "second switch" limitation, ParkerVision's argument relies on its proposed construction of "switch," which requires an "independent control input." But the Board correctly rejected this attempt to improperly limit the broad claim language. As the Board found, there is nothing in the claim language or specification that indicates that a switch must include an "independent control input." In fact, the specification includes a "Terminology" section that includes an entry for "control a switch." In that entry, the specification states that a switch is "typically" controlled by an electrical input, and that the electrical input is "typically" a different signal that the signals connected to either terminal of the switch. The specification's use of the word "typically" demonstrates that an independent control input cannot be a requirement for every "switch."

ParkerVision also points to two district court cases where a court construed the term "switch" in the '108 patent or a related patent. Those courts adopted the construction that ParkerVision advances. But the Board does not need to defer to those constructions. Instead, the Board must consider any prior claim construction from a district court. The Board did just that, and found that neither district court provided any reasoned analysis for the decision to adopt ParkerVision's proposed construction.

Because the Board's obviousness determination is supported by substantial evidence and is correct as a matter of law, this Court should affirm the Board's unpatentability finding with respect to claims 1, 6-9, 12, and 17-20 in the '108 patent.

IV. ARGUMENT

A. Standard of Review

ParkerVision has the burden to show that the Board committed reversible error. *In re Watts*, 354 F.3d 1362, 1369 (Fed. Cir. 2004). The Board applied the *Phillips* claim construction standard in this proceeding. *See* 37 C.F.R. § 42.100(b). "Claim construction is a question of law with underlying questions of fact." *Wasica Finance GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1278 (Fed. Cir. 2017). This Court "review[s] the Board's claim construction *de novo* and its underpinning factual determinations involving extrinsic evidence for substantial

evidence." *Id.* When "the intrinsic record fully governs the proper construction of a term," the Court reviews the claim construction *de novo*. *Id.*

Obviousness is a question of law based on underlying findings of fact. *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). "The determination of what a reference teaches is one of fact, as is the existence of a reason for a person of ordinary skill to combine references." *In re Constr. Equip. Co.*, 665 F.3d 1254, 1255 (Fed. Cir. 2011). This Court reviews the Board's legal conclusion of obviousness *de novo*, but must uphold the Board's fact findings if they are supported by substantial evidence. *Gartside*, 203 F.3d at 1316.

Substantial evidence is "such relevant evidence as a reasonable mind might accept as adequate to support" the conclusion reached. *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938). It is "something less than the weight of the evidence but more than a mere scintilla of evidence." *In re Mouttet*, 686 F.3d 1322, 1331 (Fed. Cir. 2012). For example, "where two different, inconsistent conclusions may reasonably be drawn from the evidence in record, an agency's decision to favor one conclusion over the other is the epitome of a decision that must be sustained upon review for substantial evidence." *In re Jolley*, 308 F.3d 1317, 1329 (Fed. Cir. 2002).

B. The Board Correctly Determined That Claims 1, 6-9, 12, and 17-20 in the '108 Patent Would Have Been Obvious

The Board rightly found that Intel met its burden to demonstrate that claims 1, 6-9, 12, and 17-20 in the '108 patent are unpatentable. Before this Court, ParkerVision does not separately argue the claims. Therefore, the Director treats claim 1 as representative. *In re Kaslow*, 707 F.2d 1366, 1376 (Fed. Cir. 1983).

1. "First Switch" Limitation

Claim 1 requires "a first switch configured to up-convert a signal based on a control signal and a bias signal." The Board correctly found that Downey discloses a circuit including an inverter that upconverts a signal based on a control signal and bias signal. Appx39; Appx46-48; Appx346-349, ¶¶ 79-85; Appx361-367, ¶¶ 101-104; Appx444. Specifically, Downey's frequency tripler includes inverter U5A, and the Board found that the inverter acts as a switch. Appx40-42. While Downey does not expressly state that inverter U5A is a "switch," Sedra discloses that an inverter is "basically a voltage-controlled switch as that represented schematically in Fig. 13.2:"

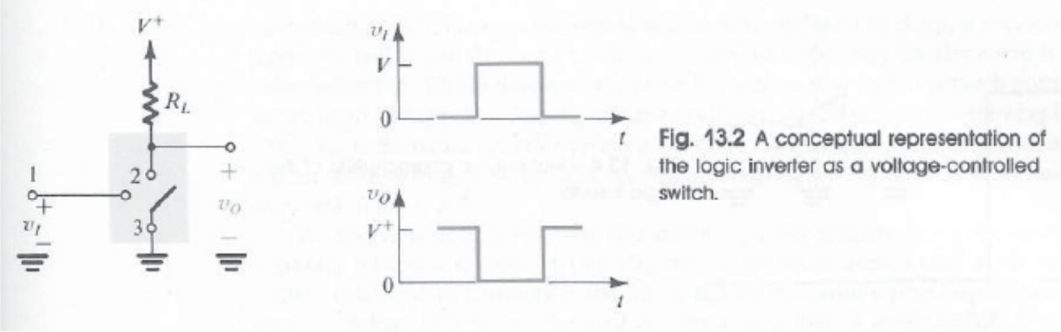


Fig. 13.2 A conceptual representation of the logic inverter as a voltage-controlled switch.

Appx478-479; *see also* Appx479 (stating that "practical implementations of the logic inverter utilize a transistor . . . as the switching element").

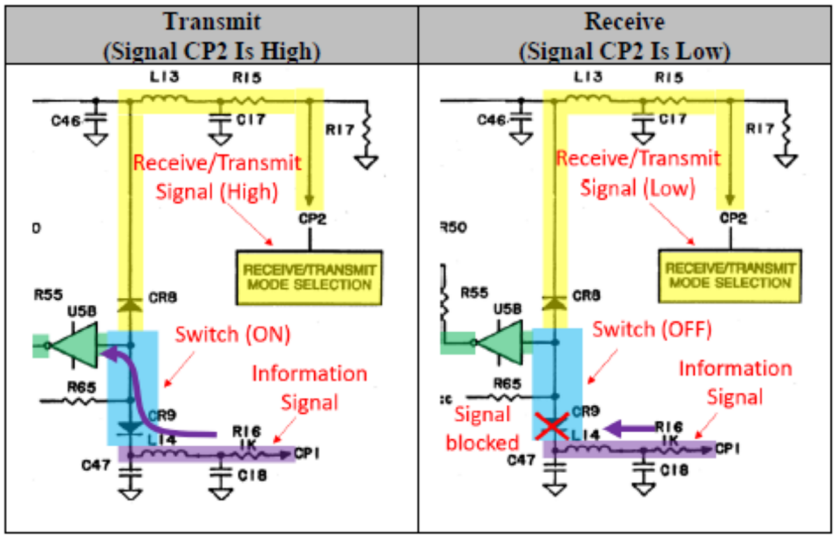
An inverter "generates an output signal by 'inverting' an input signal." Appx352, ¶ 89. As Dr. van der Weide explained, Sedra's inverter is configured in the same manner as the "first switch" disclosed in the '108 patent. Appx40-41; Appx2819-2820, ¶ 8. When input voltage v_I is high, the switch closes and connects the output voltage v_O to ground, resulting in v_O being low (i.e., 0 volts). Appx2823-2824, ¶ 14. When input voltage v_I is low, the switch opens and the output voltage v_O is connected to the bias voltage V^+, resulting in v_O being high (i.e., voltage V^+). Appx2824-2825, ¶ 15. The Board agreed with Dr. van der Weide that "Sedra's inverter has the same configuration as the switch corresponding to the claimed 'first switch' in the '108 patent." Appx41.

The Board correctly found that Intel offered a sufficient rationale for combining the references, including because both Downey and Sedra identify a goal of providing a compact transceiver by using small and energy efficient MOS transistors. Appx42. Moreover, as the Board explained, "Sedra provides a roadmap of how to construct an inverter to be used in the circuit of Downey." *Id.*

2. "Second Switch" Limitation

Claim 1 next requires that the signal is routed to the frequency conversion module "via a second switch." The Board correctly determined that Downey

discloses this second switch. Appx53. As the Board explained, Downey's Figure 2a shows that the diode CR9 "opens and closes a circuit between inverter U5B . . . and CP1." *Id.* The Board included Intel's annotated version of Figure 2a to demonstrate this:

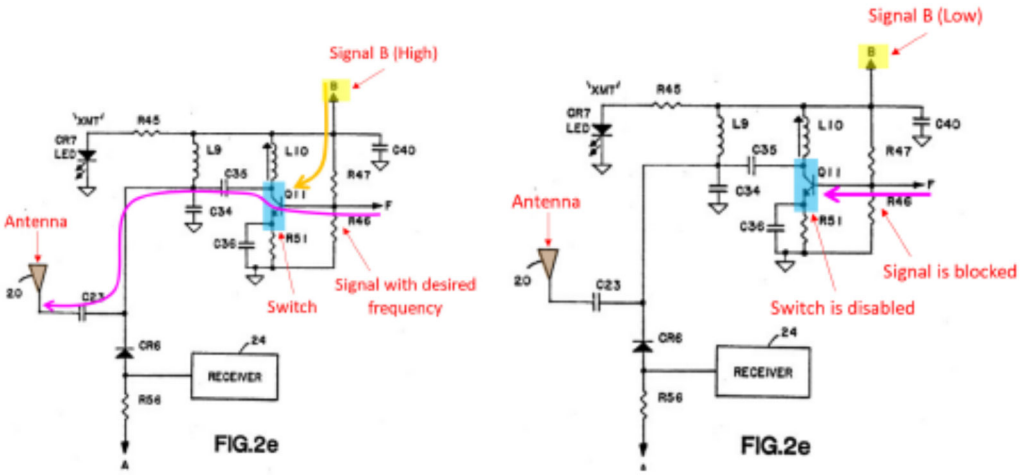


Id.; *see also* Appx2705.

Dr. van der Weide testified that the diode CR9 acts as a switch because it either allows or prevents the information signal to pass based on the value of the receive/transmit signal. *See* Appx367-370, ¶¶ 105-106; Appx2839-2847, ¶¶ 30-37. The Board credited Dr. van der Weide's testimony regarding the "second switch" limitation "because it [was] consistent with Downey's disclosure of how its circuit operates." Appx54.

3. "Third Switch" Limitation

The final limitation in claim 1 requires that the signal "is transmitted by an antenna connected to a third switch." The Board correctly found that transistor Q11 in Figure 2e of Downey meets the "third switch" limitation. Appx57. The Board focused on two annotated versions of Figure 2e to explain the operation of Q11:



Appx56; *see also* Appx2713-2714.

Dr. van der Weide testified that Q11 allows the signal to pass to the antenna depending on whether signal B is high or low. Appx373-376, ¶¶ 113-115; Appx2852-2857, ¶¶ 48-54. As shown above, if signal B is high, the switch closes and the up-converted signal (labeled as signal F) is transmitted by the antenna. Appx2855, ¶ 53. If signal B is low, the switch opens and signal F cannot reach the antenna. Appx2856-2857, ¶ 54. The Board credited Dr. van der Weide's

testimony and found that "transistor Q11 functions as a switch in Downey's power amplifier circuit" and satisfies the "third switch" limitation. Appx57-59.

C. The Board Did Not Err in Finding That the Combination of Downey and Sedra Discloses the "First Switch"

1. Substantial Evidence Supports the Board's Finding That Downey's Inverter Can Act as a Switch

ParkerVision argues that the combination of Downey and Sedra would render Downey inoperable for its intended purpose because inverter U5A is identified as "a non-linear amplifier" and not a "switch." *See, e.g.*, Br. at 47-49. This argument is based on the belief that if an inverter acts an amplifier, it cannot also act as a switch. *Id.* But the Board found substantial evidence supports the opposite conclusion. Citing to Dr. Steer's own textbook, the Board found that "amplifiers and switches are not mutually exclusive." Appx58 (citing Appx2999-3005; Appx3152); *see also* Appx2822, ¶ 12. Dr. Steer's textbook states that "a switching amplifier is ideally either fully on or fully off." Appx58 (quoting Appx3002). The Board further relied on Dr. van der Weide's testimony that "[a] POSITA would understand that a given device (such as the transistor in an inverter) can and typically does act as both a switch and an amplifier" and that "a POSITA would be aware of specific, well-known examples of transistors used for both functions." Appx58 (quoting Appx2821, ¶ 11).

The Board did not err in its decision to credit Dr. van der Weide's testimony over Dr. Steer's testimony in finding that the inverter in Downey can function both as an amplifier and a switch. *See* Appx41-42; Appx58. The Board was persuaded by Dr. van der Weide's testimony because it was based on, and consistent with, the evidence of record. *Id.* And the Board found that Dr. Steer's testimony regarding whether an inverter can function as both a switch and an amplifier was inconsistent with his own textbook. Appx58.

Similarly, ParkerVision asserts that Downey's inverter U5A cannot act as a switch because it is always on. Br. at 49. But "non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references." *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). As the Board explained, ParkerVision fails to address "why the combined circuit would also have the same non-switch characteristics that [ParkerVision] contends render Downey's inverter deficient in teaching this limitation." Appx43. The Board agreed with Dr. van der Weide's testimony that a skilled artisan would have understood from Sedra that "a switch connected to a voltage supply through a resistor realizes the logic inversion operation, allowing it to be used as an inverter in Downey's circuit just as it is disclosed in Sedra." Appx44 (citing Appx358-359, ¶ 97).

Regardless, the Board found that there was evidence supporting Intel's contention that Downey's inverter U5A is configured as a switch that toggles on and off. The Board relied on Dr. van der Weide's testimony that Downey's characterization of the inverter as a "non-linear" amplifier supports this conclusion. Appx44. Dr. van der Weide explained that a skilled artisan would have understood that a non-linear amplifier toggles between open and closed states. Appx2822-2828, ¶¶ 13-19. As support, Dr. van der Weide quoted from a textbook stating that "[n]on-linear amplifiers operate such that the transistor is saturated ('fully-ON') o[r] cut-off ('fully-OFF'), no intermediate state." Appx2822-2823, ¶ 13 (quoting Appx3119). And Dr. van der Weide explained why the non-linear amplifier in Downey switches between an on and off mode. *See, e.g.*, Appx2822-2828, ¶¶ 13-19; Appx2836-2838, ¶¶ 26-27.

Ultimately, the Board found Dr. van der Weide's well-supported expert opinion regarding the inverters in Downey and Sedra to be more credible that Dr. Steer's opinion. This Court gives the Board "broad deference" in weighing the evidence before it. *In re Inland Steel Co.*, 265 F.3d 1354, 1366 (Fed. Cir. 2001); *see also Velander v. Garner*, 348 F.3d 1359, 1371 (Fed. Cir. 2003) (explaining that "[i]t is within the discretion of the trier of fact to give each item of evidence such weight as it feels appropriate"). Moreover, this Court "defer[s] to the Board's findings concerning the credibility of expert witnesses." *Yorkey v. Diab*, 601 F.3d

1279, 1284 (Fed. Cir. 2010); *see also ESIP Series 2, LLC v. Puzhen Life USA, LLC*, 958 F.3d 1378, 1384 (Fed. Cir. 2020) ("We find no error in the Board's decision to credit the opinion of one expert over another, and we do not reweigh evidence on appeal."). Given this, substantial evidence supports the Board's determination that an inverter (such as those found in Downey and Sedra) can function as a switch even if it also serves to amplify a signal.

2. Substantial Evidence Supports the Board's Motivation Finding

ParkerVision argues that the Board erred when finding that a skilled artisan would have been motivated to combine the teachings of Downey and Sedra because "Sedra accomplishes Downey's goal of providing a compact transceiver by using small and energy efficient MOS transistors." Appx42 (citing Appx243-244). According to ParkerVision, because Downey's inverter already uses MOS transistors, "there is no reason whatsoever to modify Downey based on Sedra to include MOS transistors." Br. at 54. ParkerVision forfeited this argument by failing to raise it before the Board. The argument also fails on the merits because ParkerVision misconstrues the Board's motivation finding.

Before the Board, ParkerVision did not raise this motivation argument about MOS transistors. Appx2327-2387 (Patent Owner Response); Appx3520-3553 (Sur-Reply). Therefore, ParkerVision has forfeited the argument and cannot now raise it before this Court. *In re Google Tech. Holdings LLC*, 980 F.3d 858, 863

(Fed. Cir. 2020) ("We have regularly stated and applied the important principle that a position not presented in the tribunal under review will not be considered on appeal in the absence of exceptional circumstances."); *Watts*, 354 F.3d at 1367 ("[I]t is important that the [party] challenging a decision not be permitted to raise arguments on appeal that were not presented to the Board.").

The argument fares no better on the merits. Dr. van der Weide explained that a skilled artisan would have understood that Downey's inverter U5A contains a switch. Appx350-351, ¶ 87; Appx2817-2818, ¶ 5. But Downey does not expressly disclose this, as it does not include a detailed circuit diagram of the inverter. So, Intel offered Sedra as a secondary reference, as Sedra shows a circuit diagram of an inverter and confirms that it includes a switch. Appx351-352, ¶¶ 88-89; Appx2818, ¶ 6. Sedra's switch operates in the same manner as the first switch in the '108 patent. Appx353-356, ¶¶ 91-92; Appx2819-2820, ¶ 8. As the Board found, "Sedra provides a roadmap of how to construct an inverter to be used in the circuit of Downey." Appx42.

In mentioning the MOS transistors, the Board was not asserting that Downey does not include MOS transistors, or that it would necessary to use the MOS transistors disclosed in Sedra. Instead, the Board agreed with Dr. van der Weide's testimony that "Sedra discloses various advantages of implementing an inverter with a switch in a system like Downey's system." Appx357, ¶ 96; *see also*

Appx42. Downey identifies a goal of providing a transceiver that is compact. Appx357, ¶ 96; Appx446 at col. 1, ll. 51-55. Sedra is fully consistent with this goal, as it discloses that its switch is small and energy efficient because it is implemented with MOS transistors. Appx357-358, ¶ 96; Appx476. The Board found a reason to combine because the two references share the same goal of limiting the size of the circuit. Appx42; *see also Paice LLC v. Ford Motor Co.*, 685 F. App'x 940, 946 (Fed. Cir. 2017) (nonprecedential) (affirming the Board's motivation to combine finding when both prior art references "share the same fundamental goals"); *Thomson Licensing SAS v. Int'l Trade Comm'n*, 527 F. App'x 884, 889 (Fed. Cir. 2013) (nonprecedential) (finding a motivation to combine when the prior art references "share [a] common goal").

3. ParkerVision's Argument as to the First Switch Reflects an Overly Narrow View of Obviousness

In arguing that the transistor in Downey cannot function as both an amplifier and a switch, ParkerVision asserts that inserting the specific switch from Sedra into the specific circuit in Downey would not satisfy the "first switch" limitation because "Sedra's transistor would no longer function as a switch." Br. at 57; *see also id.* at 58-59. ParkerVision relies on Dr. Steer's testimony that the way a transistor behaves depends on factors such as the type of input signal it receives and the way it is connected in the circuit. *See, e.g.*, Appx2598-2599, ¶¶ 123-127.

ParkerVision's argument is premised on the incorrect belief that the obviousness inquiry solely focuses on modifying the frequency tripler circuit in Downey using the exact inverter of Sedra, with no other changes. ParkerVision is demanding a showing of bodily incorporation, but this Court has explained many times that such a showing is not required in an obviousness analysis. *Mouttet*, 686 F.3d at 1332 ("It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements."); *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1219 (Fed. Cir. 2016) (stating that "*KSR* does not require that a combination only unite old elements without changing their respective functions").

Obviousness is not limited to determining whether "a person of ordinary skill can only perform combinations of a puzzle element A with a perfectly fitting puzzle element B." *ClassCo*, 838 F.3d at 1219. Instead, the obviousness inquiry is "expansive and flexible" and must consider the teachings of the prior art as a whole in view of the common sense and creativity of the person of ordinary skill in the art. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415, 419-21 (2007). ParkerVision's argument fails because it does not account for the fact that a skilled artisan could further modify the circuit to ensure that the inverter acts as a switching amplifier.

D. The Board Did Not Err in Finding That Downey Discloses the "Second Switch"

During the IPR proceeding, the parties disputed the meaning of the term "switch," which appears three times in claim 1. The parties agreed that a switch was "an electronic device for opening and closing a circuit," but ParkerVision seeks to include an additional requirement that the opening and closing is "dictated by an independent control input." Appx12; Br. at 39. ParkerVision then argues that Downey's diode CR9 is not the claimed "second switch" because it lacks an independent control input. Br. at 60-61.

The Board rejected ParkerVision's attempt to narrow the scope of the claims and construed "switch" to mean "an electronic device for opening and closing a circuit." Appx25-26. Because the Board properly construed "switch," ParkerVision's argument lacks merit.

1. The Claim Language Supports the Board's Construction of "Switch"

The first step in a claim construction analysis requires looking to the claim language itself. *Immunex Corp. v. Sanofi-Aventis U.S. LLC*, 977 F.3d 1212, 1218 (Fed. Cir. 2020). "It is a bedrock principle of patent law that the claims of a patent define the invention to which the patentee is entitled the right to exclude." *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1115 (Fed. Cir. 2004).

Reviewing claim 1, the Board found no express requirement for an independent control input for every switch. Appx20. To the contrary, the Board noted that claim 1 recites use of a control signal in the first switch, but it is silent with regard to the control signal for the second and third switches. *Id.*; Appx185 at col. 65, ll 49-55. Moreover, in claim 12, there is express mention of a control signal for operation of the third switch, but nothing with respect to the first and second switches. Appx20; Appx185 at col. 66, ll. 30-38. Thus, as the Board explained, "[t]he claims . . . suggest that the patentees understood how to recite a control signal to the switch when the patentees intended to do so, but did not add an independent control input requirement" for every claimed "switch." Appx20; *see also Hologic, Inc. v. Minerva Surgical, Inc.*, 44 F.4th 1358, 1368 (Fed. Cir. 2022) (explaining that the fact that the inventors chose to include a limitation in a some, but not all, claims indicates that they did not intend for the limitation to apply to all claims). Notably, ParkerVision mentions nothing about the claim language in arguing for its more limited claim construction. *See, e.g.*, Br. at 39-44.

2. The Specification Contradicts ParkerVision's Narrow Construction of "Switch"

The "claims 'must be read in view of the specification, of which they are a part.'" *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005) (en banc) (citation omitted); *see also id.* (stating that the specification "is the single best guide to the meaning of a disputed term"). But "[w]hen consulting the

specification . . . courts must take care not to import limitations into the claims from the specification." *Abbott Lab'ys v. Sandoz, Inc.*, 566 F.3d 1282, 1288 (Fed. Cir. 2009).

The '108 patent specification contains a section titled "Terminology." The descriptions in this section are "provided for illustrative and convenience purposes only, and [are] not limiting." Appx156 at col. 7, ll. 24-26. Included in that section is the following:

> Control a switch: Causing a switch to open and close. The switch may be, without limitation, mechanical, electrical, electronic, optical, etc., or any combination thereof. *Typically*, it is controlled by an electrical or electronic input. If the switch is controlled by an electronic signal, it is *typically* a different signal than the signals connected to either terminal of the switch.

Appx156 at col. 7, ll. 57-63 (emphasis added).

This paragraph is important in understanding the intended meaning of "switch." The second sentence includes an open-ended listing of the types of known switches. The third and fourth sentences state that a switch is "typically" controlled by an electronic signal, and that the signal is "typically" a signal different than the signals connected to the terminals of the switch. This Court has explained that the word "typically" connotes a description of "only the most common embodiment rather than the full scope of the invention." *Praxair, Inc. v. ATMI, Inc.*, 543 F.3d 1306, 1323 (Fed. Cir. 2008).

The Board correctly noted that "a different signal than the signals connected to either terminal of the switch" is the "independent control input" in ParkerVision's proposed construction. Appx22. Thus, ParkerVision's "proposed construction seeks to *limit* the term 'switch' to what is expressly stated in the Specification as *typical*." *Id.* (emphasis in original). "It is . . . important not to confuse exemplars or preferred embodiments in the specification that serve to teach and enable the invention with limitations that define the outer boundaries of claim scope." *Intervet Inc. v. Merial Ltd.*, 617 F.3d 1282, 1287 (Fed. Cir. 2010).

ParkerVision primarily relies on the figures in the '108 patent specification (and their accompanying descriptions) that depict a switch controlled by an independent control input. Br. at 40-43. But these embodiments, even if they are the only embodiments found in the specification, are insufficient to limit the claims. *Thorner v. Sony Computer Ent. Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

Instead, this Court will depart from the plain and ordinary meaning of the claims when there is a clear showing that the patentee defined a claim term or disavowed claim scope. *GE Lighting Solutions, LLC v. AgiLight, Inc.*, 750 F.3d 1304, 1309 (Fed. Cir. 2014). ParkerVision does not even assert that these disclosures in the specification meet the "exacting" standard necessary for a disclosure in the specification to narrow the plain and ordinary meaning of the

claim language. *Id.*; Br. at 40-43. Moreover, not only does the specification fail to include the clear restrictive language necessary to limit the claims, it includes a "Terminology" section that expressly recites a broader meaning of the term "switch." Appx156 at col. 7, ll. 57-63. Therefore, the embodiments that ParkerVision identifies cannot impose an "independent control input" limitation on the meaning of "switch."

3. The Board Did Not Err Merely Because its Construction Differs From the District Court Constructions

Two district courts have construed the term "switch" in the context of the '108 patent, or a related ParkerVision patent. ParkerVision argues that the Board erred by "afford[ing] no deference to the District Courts." Br. at 39. ParkerVision is incorrect in asserting that the Board is obligated to show deference to the district court claim constructions. Instead, the applicable rule requires only that the Board must consider any prior district court claim construction determination. 37 C.F.R. § 42.100(b) (stating that "[a]ny prior claim construction determination concerning a term of the claim . . . that is timely made of record in the *inter partes* review proceeding will be considered"); *see also VLSI Tech. LLC v. Intel Corp.*, 53 F.4th 646, 651 (Fed. Cir. 2022) (finding that the Board "considered" a prior district court claim construction even when the Board's decision did not specifically mention the prior claim construction). The Board did exactly that, *see* Appx15-19, and ultimately reached a conclusion different than the district courts.

In addition, ParkerVision fails to acknowledge that neither district court provided any reasoned analysis behind the construction, thus offering the Board nothing to consider beyond the fact that the court adopted ParkerVision's construction of "switch." The Board first looked to the claim construction orders from the district court in Texas. Those orders consist of charts showing the term to be construed, the parties' proposed constructions, and the court's adopted construction. Appx15-16; Appx2391-2406; Appx2407-2414. The charts include no reasoning or explanation from the court—they merely list the court's adopted constructions. *Id.* And, as the Board noted, ParkerVision did not point the Board to any transcripts from the *Markman* hearing that included the district court's reasoning with regard to the construction of "switch." Appx18, n.10. Thus, the Board was "deprived of the court's reasoned analysis that resulted in the court's construction" of "switch." Appx17.

Next, the Board looked to the claim construction order from the district court in Florida. The district court adopted ParkerVision's proposed construction of "switch," and offered two reasons for doing so. Appx2438-2446. First, the court noted that the defendant, Qualcomm, agreed with ParkerVision's proposed construction at one of the two *Markman* hearings that the court held. Appx2446. Second, the court stated that it "agrees with ParkerVision . . . that the embodiments and teachings of the patent as a whole support Plaintiff's construction of

'switch/switching module.'" *Id.* Yet again, the Board lacked "the court's reasoned analysis that may have resulted in the court's decision to adopt that construction." Appx18-19.

4. Under the Board's Construction of "Switch," There is No Dispute that Downey Discloses the "Second Switch"

Based on its construction of "switch," the Board correctly found that Downey's diode CR9 meets the "second switch" limitation of claim 1. Appx51-54. While ParkerVision challenges this finding, its challenge is limited to arguing that the Board misconstrued "switch." *See* Br. at 60-61 (arguing that the Board's obviousness finding should be reversed or vacated "[i]f this Court agrees with Appellant's claim construction of 'switch.'"). Under the Board's construction of "switch," ParkerVision does not dispute that Downey's diode CR9 is the claimed "second switch." Because the Board correctly construed "switch," ParkerVision's challenge regarding the "second switch" limitation fails.

E. The Board Did Not Err in Finding That Downey Discloses a "Third Switch"

ParkerVision does not offer a unique argument regarding the claimed "third switch." Instead, it points back to its earlier argument that a transistor cannot act as both an amplifier and a switch. Br. at 63. But the Board credited Dr. van der Weide's testimony that a skilled artisan "would understand that a given device (such as the transistor in an inverter) can and typically does act as both a switch

and an amplifier." Appx58 (quoting Appx2821, ¶ 11). The Board also relied on Dr. Steer's textbook, which describes "switching amplifiers" and explains that switching amplifiers are either fully on or fully off. Appx58 (citing Appx2999-3005). The Board's fact findings are therefore supported by substantial evidence.

F. The Board's Decision Does Not Rely on a New Theory Not Raised in the Petition

Finally, ParkerVision argues that the Board's determination that Downey discloses the claimed "third switch" improperly relies on a theory not found in Intel's IPR Petition. Br. at 63-65. ParkerVision has forfeited this argument by failing to raise it before the Board.

Specifically, ParkerVision contends that Intel's Reply raised a theory regarding the "third switch" limitation that was not present in the petition. But ParkerVision filed a Sur-Reply in response to Intel's Reply, and ParkerVision's Sur-Reply did not call out this alleged new theory. Appx3549-3550; *see also Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1081 (Fed. Cir. 2015) (noting the ways that a patent owner can respond to alleged new evidence in a Reply).[9]

[9] ParkerVision understood that it was able to use its Sur-Reply to argue that Intel's Reply raised new theories, as it made this argument with respect to issues other than the "third switch" limitation. *See, e.g.*, Appx3533-3534 (asserting that Intel's Reply raised an inherency argument not found in its Petition).

Because ParkerVision had the opportunity to raise this argument before the Board and chose not to do so, ParkerVision cannot now raise the argument before this Court. *Google Tech. Holdings LLC*, 980 F.3d at 863; *Watts*, 354 F.3d at 1367. Had ParkerVision raised the argument before the Board, the Board could have determined whether to exclude Intel's Reply as violating 37 C.F.R. § 42.23(b). *See Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369-70 (Fed. Cir. 2016) (finding that the Board did not err in excluding a Reply because the Reply raised an "entirely new rationale" to explain the motivation to combine references).

The argument also fails on the merits. In its Petition, Intel asserted that transistor Q11 in Downey is the claimed "third switch." Appx255-258. In its Reply, Intel reiterated this position. Appx2710-2715. Intel raised the issue of "switching amplifiers" only in response to ParkerVision's argument that Q11 cannot be a switch because it is instead "configured to operate as a 'power amplifier.'" Appx2710-2711 (responding to Appx2384-2386 (Patent Owner's Response)). The point of Intel's "switching amplifiers" argument was not to raise a new theory with regard to what element in Downey satisfies the "third switch" limitation; it was intended to rebut ParkerVision's argument that because a transistor is acting as an amplifier, it cannot also act as a switch. *Id.*

There is no prohibition against using the Reply to respond to an argument raised in the Patent Owner response. *See* 37 C.F.R. § 42.23(b); *Chamberlain Group, Inc. v. One World Techs., Inc.*, 944 F.3d 919, 925 (Fed. Cir. 2019) (finding that a party does not raise a new argument when it offers "a clarification of its prior position in response to the arguments" raised by the other party). And while ParkerVision complains about Intel's submission of new evidence with the Reply (Br. at 64-65), a petitioner may submit rebuttal evidence in support of its Reply. *Belden*, 805 F.3d at 1077-78.

V. CONCLUSION

For the foregoing reasons, the Board's decision should be affirmed.

Respectfully submitted,

July 3, 2023

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CERTIFICATE OF COMPLIANCE

I hereby certify that the foregoing brief complies with the type-volume limitation in Fed. Cir. R. 32(b). The total number of words in the foregoing brief is 8,326, as calculated by Microsoft Word 2019.

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